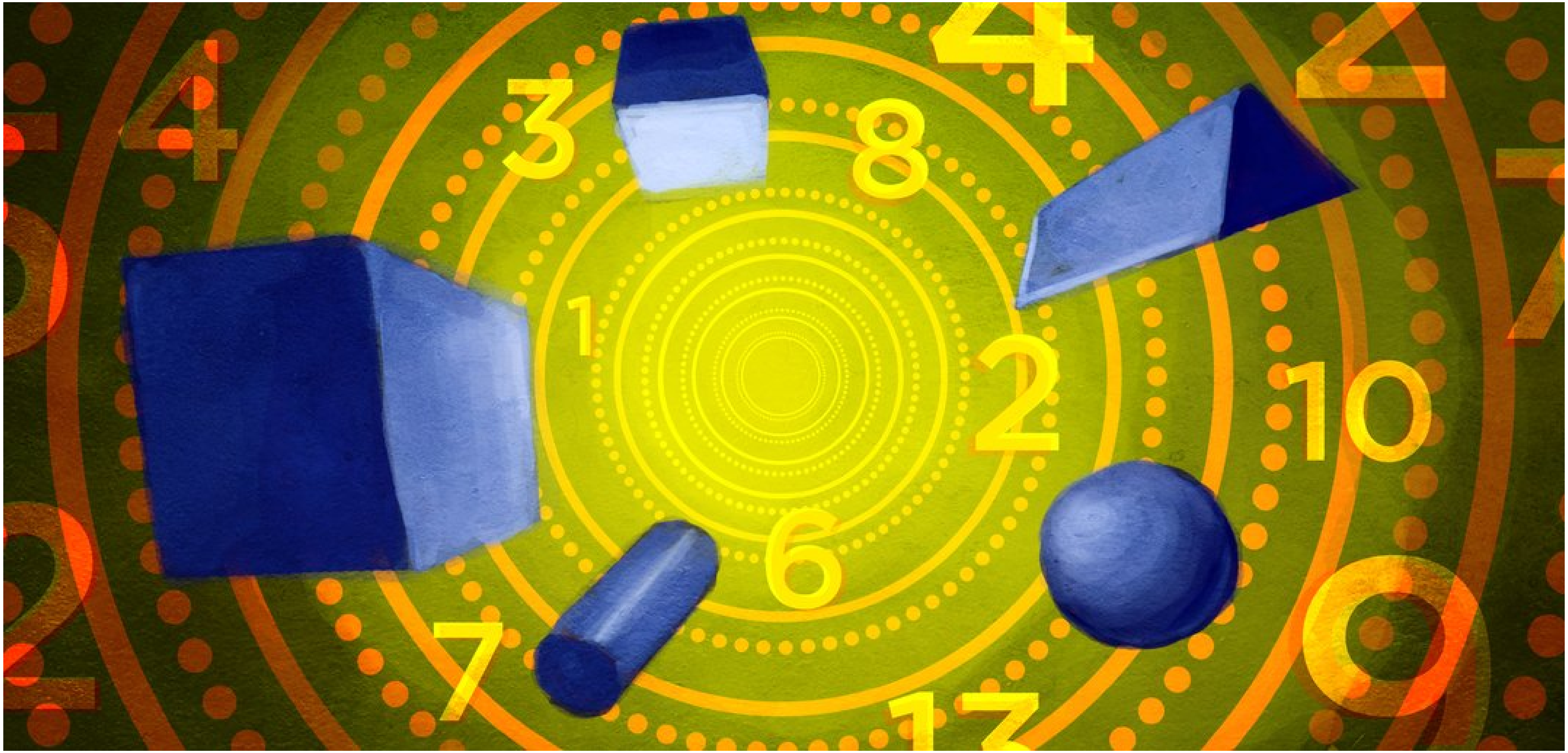


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अद्भुत फिबोनाची अंक-शृंखला The Fascinating Fibonaccis

Level 4

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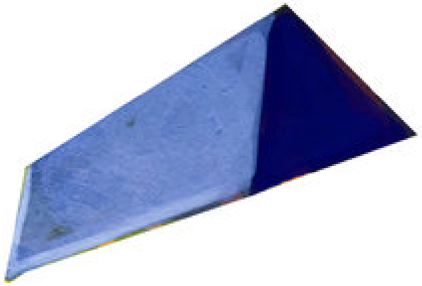
सभ दिन हमरा सभकेँ संख्यासँ काज पड़िते अछि। चीज सभक गनती लेल, नाप-जोख करय लेल, फोनपर मित्रसँ बात करय लेल आ एतऽ धरि जे कोनो बौस्तुक मूल्यक पता करबाक लेल हम सभ अंकक सहयोग लइ छी। मुदा अहाँकेँ ई बूझल अछि जे संख्याक उपयोग कऽ कय ज्यामितीक आकार आ विभिन्न अरिपन सभ बना सकै छी? की अहाँकेँ ई बूझल अछि जे प्रकृतिमे जे अद्भुत पुनः-पुनः आबैबला चित्र देखाइ पड़ैत अछि सेहो अंकक पुनरावृत्तिपर निर्भर अछि? Numbers. We use them every day. To count, measure, call friends on the phone and even to find out what something costs. But did you know you can also use numbers to create patterns - geometrical shapes, rangoli designs, and more? Did you know number patterns can be seen within patterns in nature?

मुदा पहिने ई बूझब आवश्यक अछि जे अंक सभक पुनरावृत्ति कोन तरहेँ होइए? अंकक शृंखलामे एक अंकक अगिला-पछिला अंकसँ एक तरहक सरोकार होइ छै। जेना एकटा सरल अंकक शृंखला ली:: ०,१,२,३,४... ऐ अंकक शृंखलामे सभ अंकक अपनासँ पाछाँबला अंकसँ कोन तरहक सरोकार छै? उत्तर अछि जे ऐ शृंखलामे अगिला अंक पाछाँबला अंकमे १ जोड़ला सँ बनैत अछि। एकटा आर शृंखला देखू:: १४, १२, १०, ८, ६.. ऐ शृंखलामे अगिला अंक अपन पछिला अंकमे २ घटेला सँ बनैत अछि।

But first, what is a 'Number Pattern'? A Number Pattern is a sequence of numbers where each number is connected to the previous one in ONE specific way.

Take this very simple number pattern: 0, 1, 2, 3, 4... How is each number in this sequence connected to the one before it? Well, every number in this sequence is the previous number with 1 ADDED to it.

Here's another number pattern: 14,12,10, 8, 6... Each number in *this* sequence is the previous number with 2 SUBTRACTED from it.



आब किछु आर भरिगर शृंखला देखै छी:: ०,१,३,६,१०,१५... ऐ शृंखलाक की खूबी अछि? ऐमे प्रयुक्त अंकक पुनरावृत्ति कोना होइत अछि?

०+१=१; १+२=३; ३+३=६, ६+४=१०; १०+५=१५

की अहाँ ऐमे कोनो पुनरावृत्ति देखै छी? १५क बाद ऐ शृंखलामे कोन संख्या एतै? की २१ !

पुनरावृत्ति एना भेल १५+६=२१

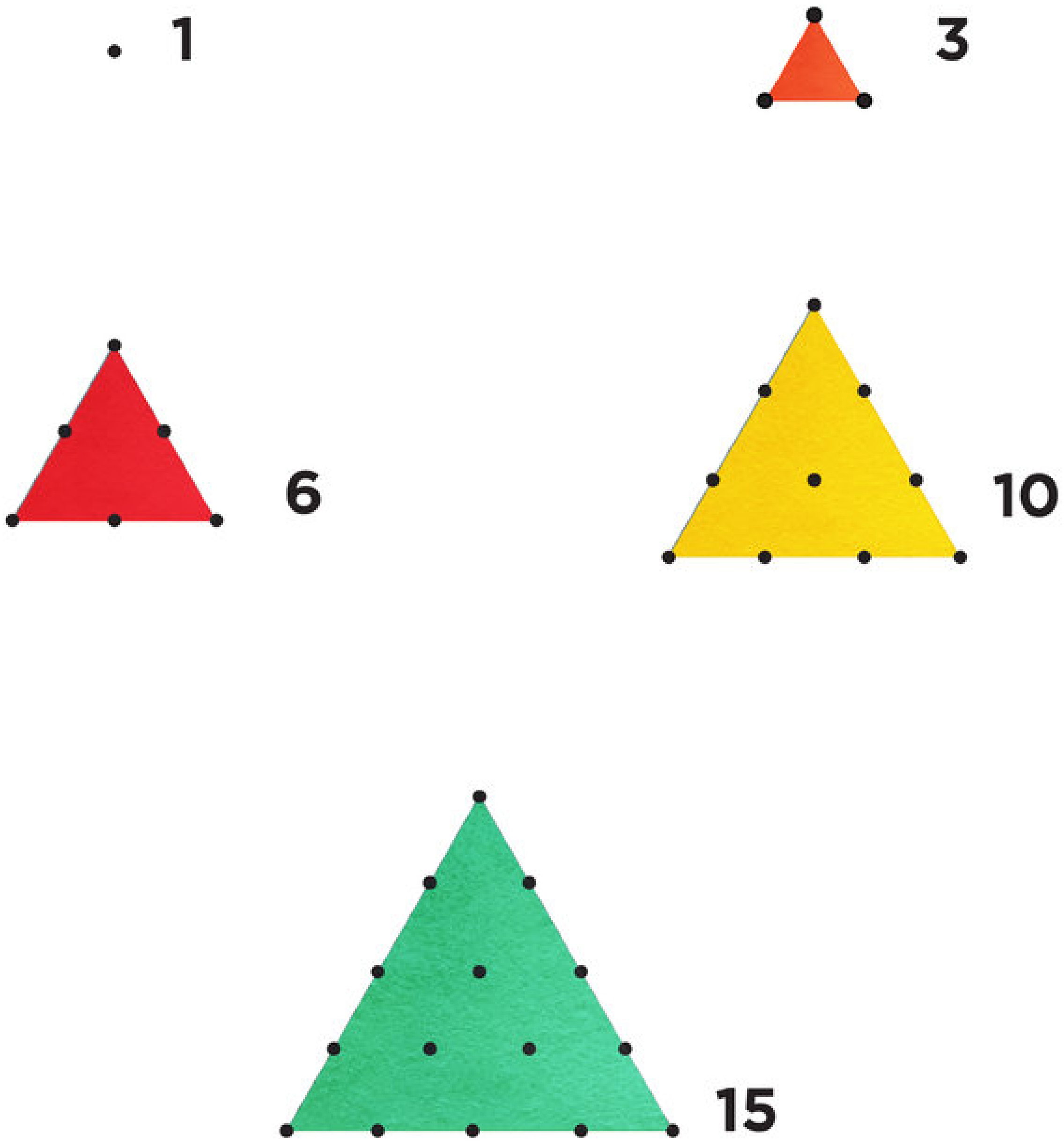
Now for a slightly more tricky pattern: 0, 1, 3, 6, 10, 15...

How does this sequence work? Let's see.

0 + 1 = 1: 1 + 2 = 3: 3 + 3 = 6: 6 + 4 = 10: 10 + 5 = 15

Do you see the pattern here? What will the next number in this sequence be? Yes, 21, because 15 + 6 = 21.





जइ अंक सभक पुनरावृत्ति माने १,३,६,१०,१५... हम सभ बुझलौं अछि की ओकर आकृति बनि सकैए? बनि सकैए! अंक लेल बिंदु आ शृंखलामे बिंदु सभ बढ़ैत त्रिभुजक आकार लेत। देखू! कोना अंकसँ बनल एकटा शृंखला आ आकृतिक पुनरावृत्ति सेहो भेल।

Now, let's take the 'number pattern' we just discussed: 1, 3, 6, 10, 15... , and see if we can create a 'SHAPE pattern' from it.

We can! We now have a 'shape pattern' of triangles that get bigger and bigger as we increase the number of dots according to our number pattern!

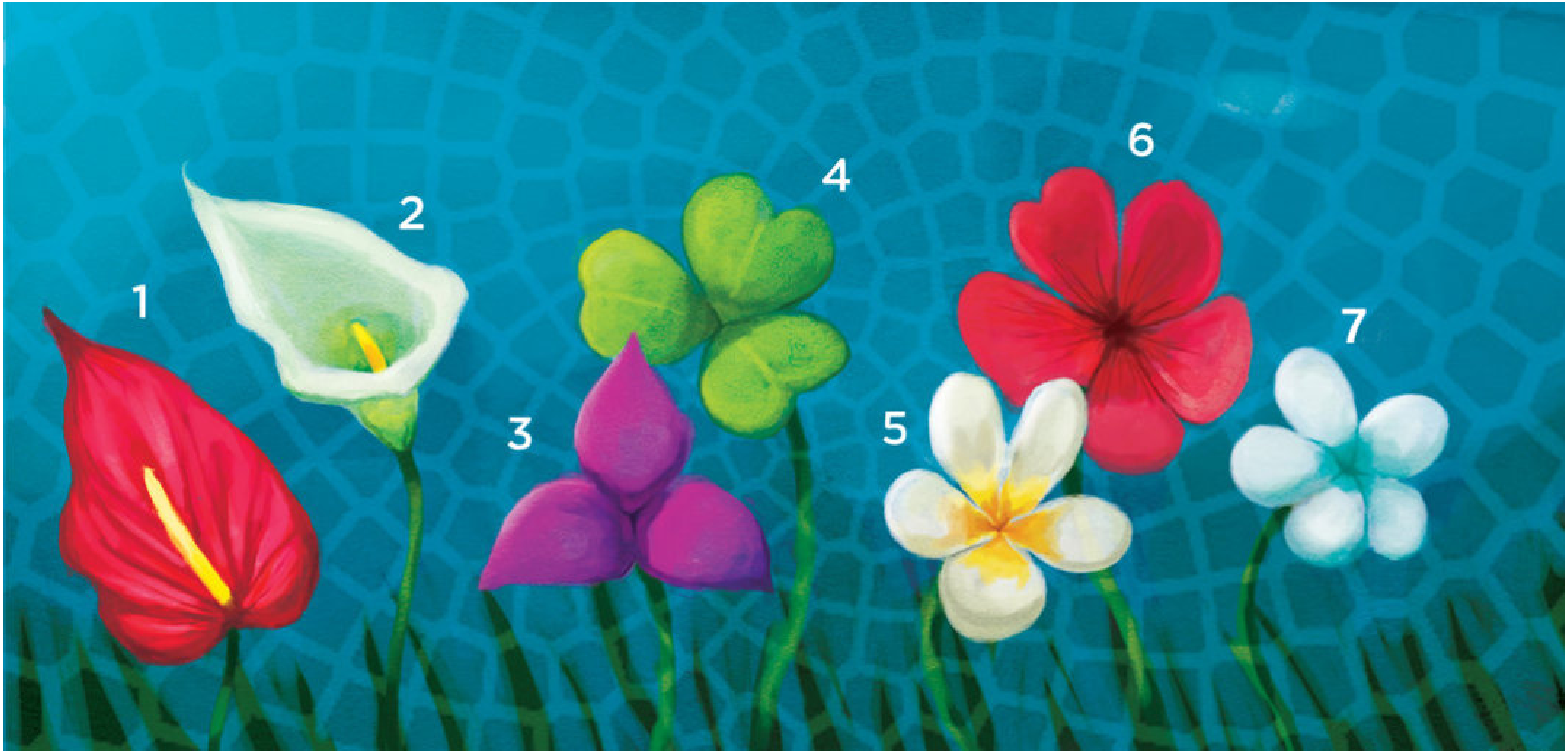
A number pattern has become a shape pattern!

अद्भुत्? आब अंक-शृंखलाक एकटा आरो उदाहरण लिअ। एकर नाम छी फिबोनाची शृंखला, आ से गर्वसँ अंकक "हेमचन्द्र" सेहो कहल जा सकैए।

ई शृंखला अछि:: ०,१,१,२,३,५,८,१३,२१,३४...की ऐमे पुनरावृत्ति स्पष्ट अछि? नीक! सही चिन्हलौं...... ऐलेल फिबोनाची शृंखला प्रयुक्त होइत अछि। माने ऐमे तेसर अंकक बाद सभ अंक अपनासँ पूर्व अंकमे दू जोड़लासँ बनल अछि। एना:: ०+१=१; १+१=२; २+१=३; ३+२=५; ५+३=८; ८+५=१३; १३+८=२१; २१+१३=३४ बुझलौं? नीक! ऐ फिबोनाची अंक-शृंखलाक पुनरावृत्ति प्रकृतिमे ठाम-ठाम देखा पड़त। कोना? चलू देखी...

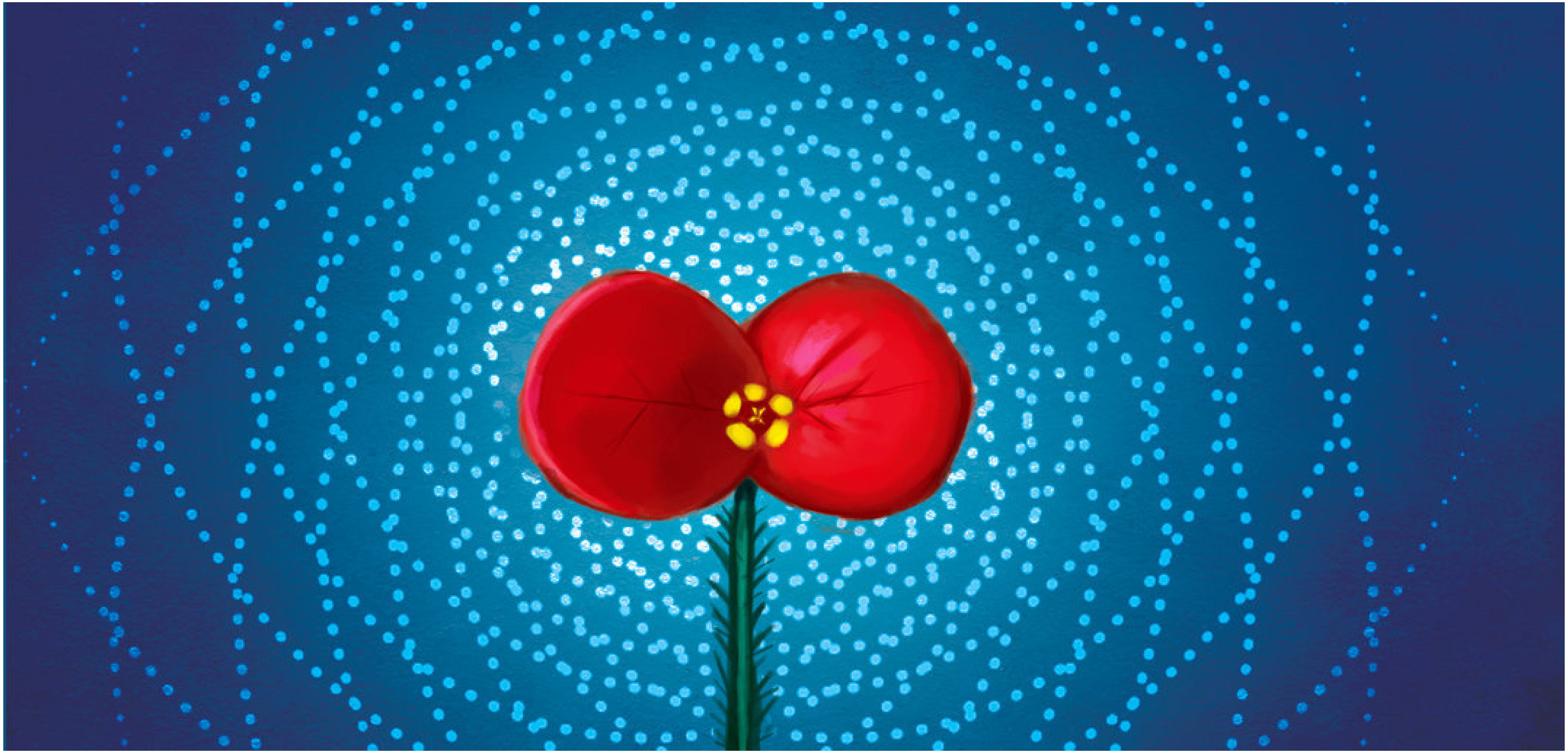
If you found that interesting, it's time you were introduced to a beautiful number sequence called the Fibonacci (or Hemachandra) Sequence of numbers. The Fibonacci Sequence of numbers goes like this: 0, 1, 1, 2, 3, 5, 8, 13, 21, 34...Can you find the pattern that connects these numbers? Yes! Every number in the Fibonacci Sequence is the sum of the two numbers before it! Like this. 0+1 = 1 1+1 = 2 2+1 = 3 3+2 = 5 5+3 = 8 8+5 = 13 13+8 = 21 21+13 = 34 Got it? Good. Now for the REALLY interesting part - linking this number pattern to patterns in nature.





फूल सभमे पँखुरि सभ फिबोनाची अंकपर आधारित अछि! जइ फूलमे १,३ बा ५ पँखुरि अछि से की छी! ई सभ फिबोनाची अंके तँ छी! मोन पारी ऐ फूल सभकेँ: १ पँखुरिबला फूल-(१)ऐंथूरियम (२)कल्ला लिली। ३ पँखुरिबला फूल-(३) बोगनविलिया,(४) क्लोवर।५ पँखुरिबला फूल-(५) मन्दिर गाछ,(६) जवाकुसुम,(७) चमेली।

The number of petals flowers have are often linked to Fibonacci numbers! Can you think of flowers with 1, 3 and 5 petals? (These are allFibonacci numbers.) Here are some examples to help you along. 1 petal - 1. Anthurium; 2. Calla lilies 3 petals - 3. Bougainvillea; 4. Clovers 5 petals - 5. Temple tree; 6. Hibiscus; 7. Jasmine



दू पँखुरिबला फूल बड्ड कम अछि। "क्राउन ऑफ थॉर्न्स"दू पँखुरिबला फूलक एकटा उदाहरण अछि। मुदा चारि पँखुरिबला फूल सेहो कम्मे होइत अछि (४ फिबोनाची अंक नै छी)। आब जखन कोनो फूल देखी तँ ओकर पँखुरि गानि कऽ देखब जे ओकर संख्या कतेक छै,। Flowers with 2 petals are not very common. The Crown of Thorns, which you see here, is one example.
Flowers with 4 petals (4 is NOT a Fibonacci number) are also rare.
Count the petals of flowers that you come across and see for yourself!



फिबोनाची अंक लेल डेजी फूलक उदाहरण सर्वोत्कृष्ट अछि। ऐ फूलक विभिन्न प्रकारमे पँखुरिक संख्या विभिन्न होइत अछि, कतौ १३, कतौ २१ तँ कतौ ३४। आ ई सभटा अंक फिबोनाची अंक थिक।

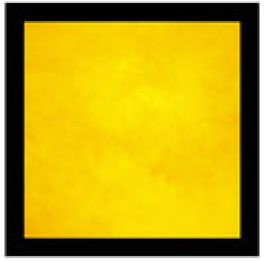
The most interesting flower of all, where the Fibonacci sequence is concerned, is the daisy. Different daisy species have 13, 21, or 34 petals - which are all Fibonacci Numbers!

प्रकृतिमे आरो आश्चर्यपूर्ण फिबोनाची अंकपर आधारित शृंखला भेटैत अछि। गणितसँ हमरा सभ लेल ई हल्लुक भऽ जायत। देखै छी......जँ हम फिबोनाची अंकक पहिल किछु अंकक वर्ग (*) बनाबी तखन परिणाम की भेटत? फिबोनाची शृंखलाक अंक: १,१,२,३,५,८,१३ आदि। ऐ सभक वर्ग: माने १*१=१; २*२=४; ३*२=९; ५*२=२५; ८*२=६४; १३*२=१६९. से फिबोनाची शृंखलाक वर्ग भेल: १,४,९,२५,६४,१६९...।

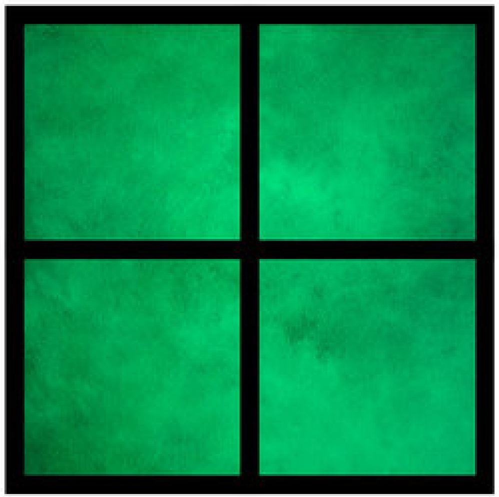
(*)कोनो अंकक ओही अंकसँ गुणाक गुणनफल ओइ अंकक वर्ग कहाइए।

There are even more complex and stunning patterns in nature that appear to be based on the Fibonacci numbers. If you are willing to do a little math, you can see it for yourself. Shall we try it out? Now, what would we get if we squared* each of the numbers in the Fibonacci sequence? Fibonacci Sequence: 1, 1, 2, 3, 5, 8, 13, etc. If we 'squared' each of these numbers, we would get: 1 x 1 = 1 Squared or 1^2= 1 2 x 2 = 2 Squared or 2^2= 4 3 x 3 = 3 Squared or 3^2= 9 5 x 5 = 5 Squared or 5^2= 25 8 x 8 = 8 Squared or 8^2= 64 13 x 13 = 13 Squared or 13^2= 169 So the Fibonacci Sequence Squared: 1 – 4 - 9 – 25 – 64 – 169 - etc.

When you multiply a number by itself, the number is 'squared'.



1^2



2^2

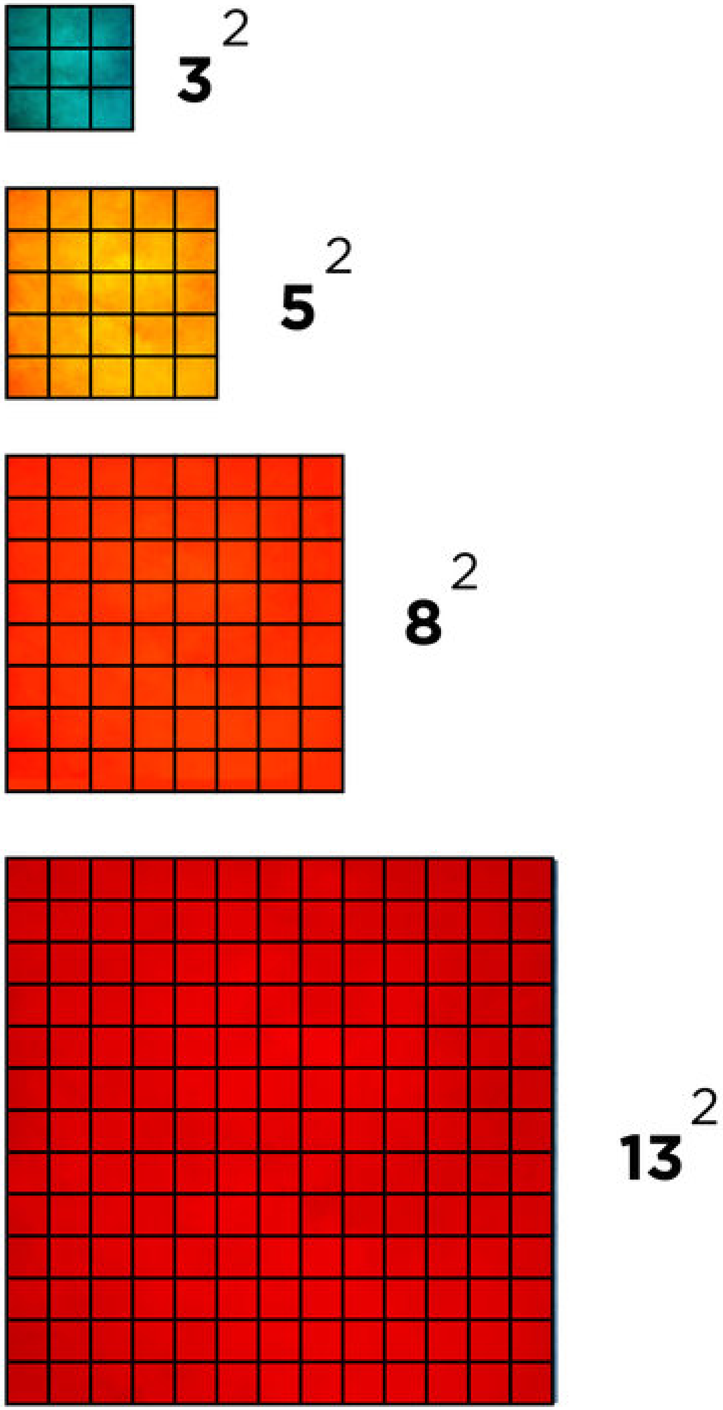
पहिने हम त्रिभुजसँ बुझेने छलौं, आब ऐ फिबोनाची शृंखलाक वर्ग सभकेँ सेहो एकटा चौकोर आकृति देबाक प्रयास करब।से १*१, २*२, ३*३ आदिकेँ चौकोर ज्यामितिक आकृति बना सकै छी। १*१ लेल एकटा चौकोर वर्ग, २*२ लेल वामसँ दहिन २टा चौकोर वर्ग आ ऊपरसँ नीचाँ २टा आरो चौकोर वर्ग माने ४ टा वर्ग कारण २*२=४ होइत अछि (ई आकृति ग्रिड भेल)।

Now, just like we converted a number pattern into a shape pattern with the triangles before, let's try to convert the Fibonacci Sequence Squared into a shape pattern. Let's try to DRAW 1^2, 2^2 , 3^2 and so on.

1^2 is easy enough – it is just one square.

2^2 is drawn like this - 2 squares across and 2 squares down.

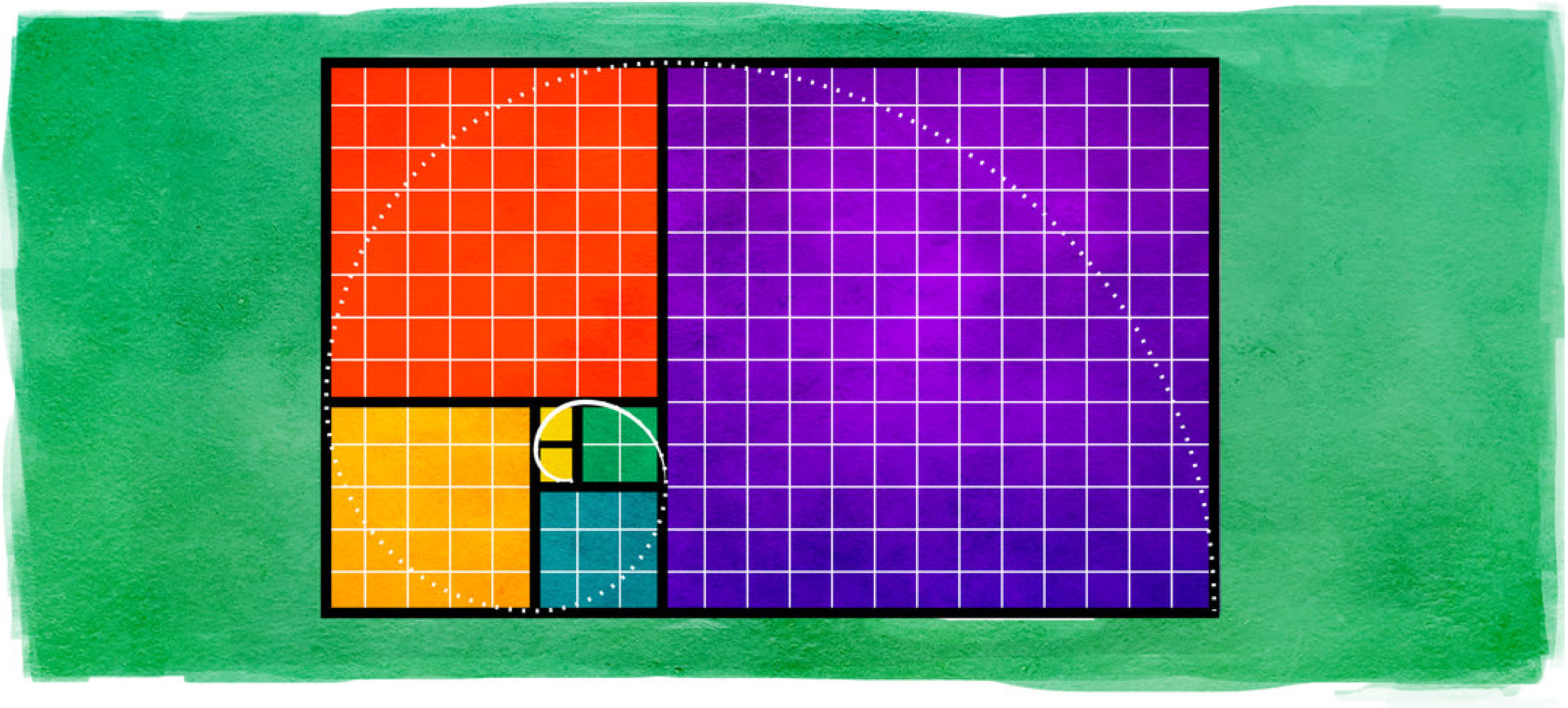
We know that $2^2 = 4$, and there are 4 squares in the figure (we call this figure a 'grid').



आब ३*३ कँ ग्रिड सन देखै लेल ३टा वर्ग वामसँ दहिन आ तीनटा वर्ग ऊपरसँ नीचाँ बनाउ। ३*३=९ होइत अछि, तइ लेल ऐ ग्रिडमे ९टा वर्ग हएत। ५*५ मे तहिना २५ वर्गक ग्रिड बनत। ८*८मे ६४ टा वर्ग आ १३*१३ मे १६९ टा वर्गबला ग्रिड बनत आ अहिना आगाँक गणना कऽ सकैत छी आ आगाँक संख्याक वर्गक लेल ग्रिड बना सकैत छी? आ जँ बना सकब तकर माने भेल जे अहाँ पाठ नीकसँ बुझि गेलौं।

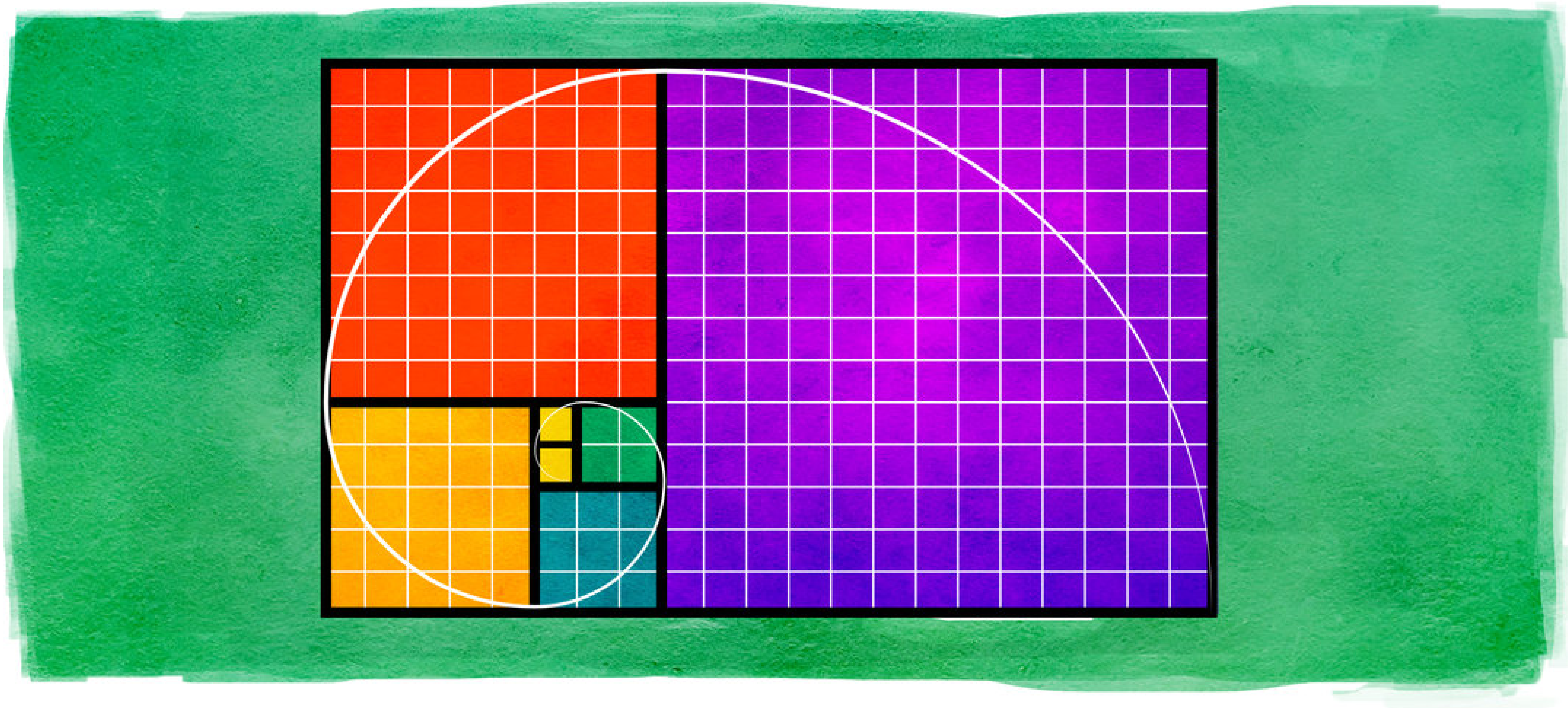
Similarly, 3^2 is drawn as 3 squares across and 3 squares down. Again, we know that 3^2 = 9, and there are 9 squares in the grid.

5^2 is drawn as 5 squares across and 5 squares down, making a grid with 25 squares, 8^2 as 8 squares across and 8 squares down, making a grid with 64 squares, 13^2 squared is drawn as a grid with 169 squares, and so on.



आब अखन धरि बनाओल सभटा ग्रिडकेँ ऐ चित्र जकाँ सजा दियौक। फेर हल्लुक हाथसँ (ऐ चित्र सन) सभसँ छोट ग्रिडक छोरसँ वक्ररेखा बनबैत ओकरा दोसर छोर धरि लऽ जाउ।

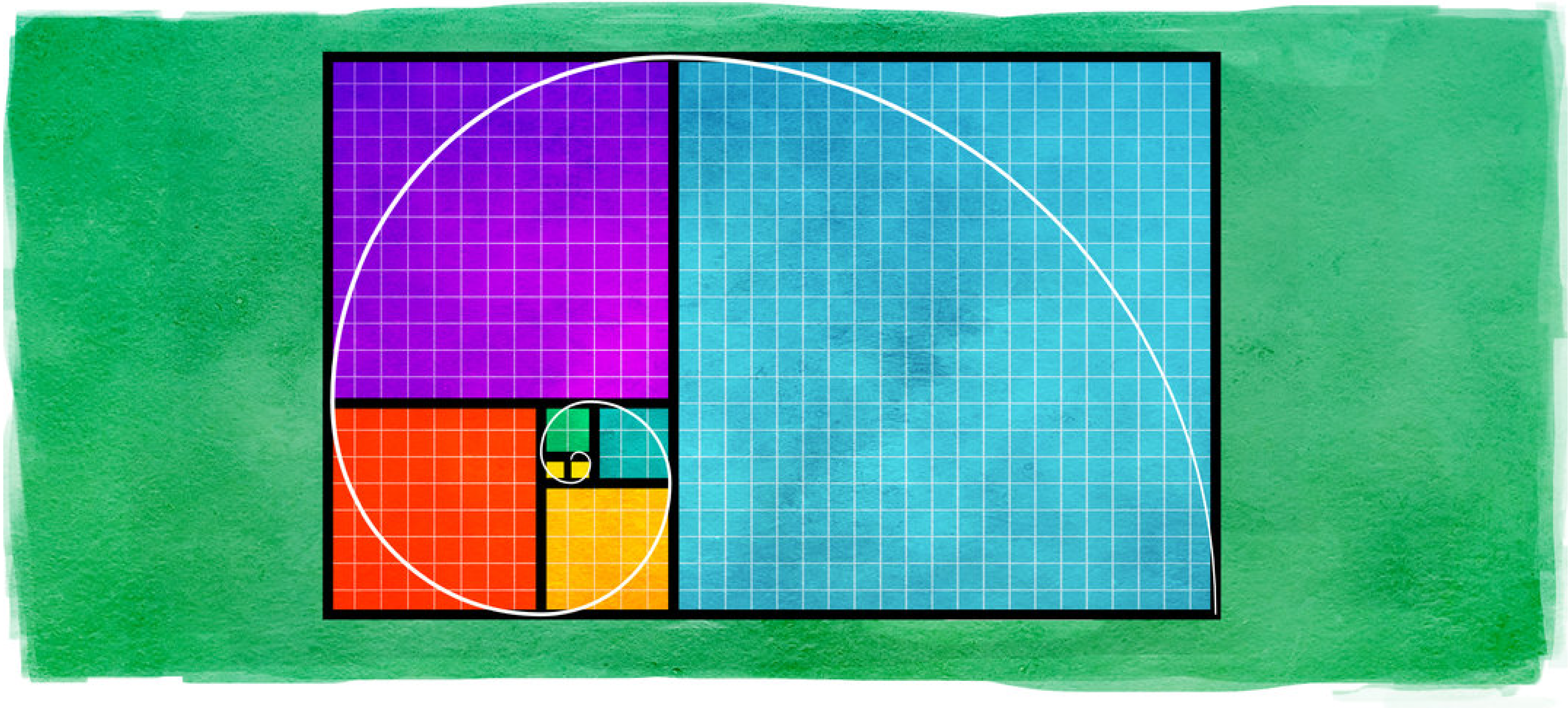
Now, let's push all the grids we've drawn so far towards each other, and arrange them like in the picture. Done? Now draw a smooth curved line from one corner of the smallest grid to its opposite end, as shown in the figure.



आब ऐ वक्र रेखाकेँ हल्लुक हाथेँ बढ़बैत दोसर, तेसर ग्रिड... १३म ग्रिड धरि लऽ जाउ। आब एकटा विशिष्ट कुण्डली सन संरचना बनि जायत फिबोनाची अंकक वर्ग सभसँ बनल ऐ आकृति आ प्रकृतिक बीच कोनो संबंध अछि? एन-मेन एहने फिबोनाची स्पाइरल प्रकृतिमे सेहो देखल जाइत अछि, कतऽ!

Now take the same curved line through each of the other grids, from smallest to biggest, from corner to opposite corner, ending with the 13 squared grid. What we get is a lovely spiral pattern.

What is the link between this spiral pattern created by squared Fibonacci numbers, and nature? Well, the exact same Fibonacci Spiral can be found in nature! Where? Let's see, shall we?



एतऽ एकटा फिबोनाची कुण्डली देल अछि, जइमे एकटा आर ग्रिड, २१*२१ जोड़ल गेल अछि। देखियौ जे ई कुण्डली केना आगाँ बढ़ैत अछि? ई कुण्डली देखल सन लगैत अछि?

Here's the Fibonacci Spiral with one more grid - 21^2 - added to our original figure. See how the spiral continues? Does the spiral look familiar?

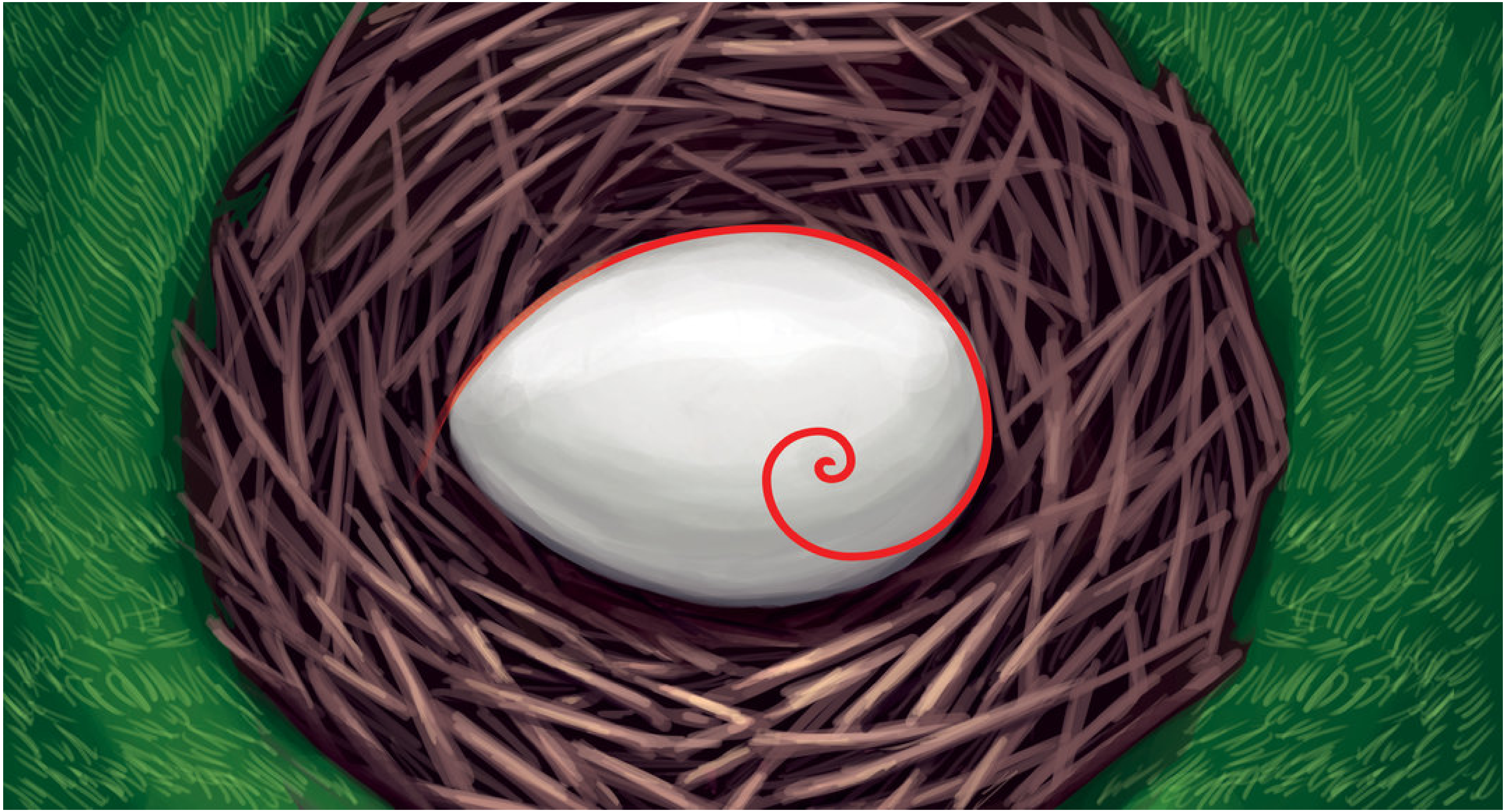


अवश्ये लगैत अछि! ई फिबोनाची कुण्डली समुद्रक सीपमे देखि सकै छी (भने पछिला पन्नापर देल सम्पूर्ण कुण्डलीकेँ देखै लेल अहाँकेँ अपन गरदनि कने घुमबऽ किए नै पड़य। Of course it does!You can see the Fibonacci spiral in seashells (although you might have to twist your head around a bit to see the exact spiral pattern of the previous page)...



.. डोकाक खोली

... snail shells



..एते धरि जे अंडा सेहो (देखू ऐ कुण्डलीक ई घूर्णन पथ, ई पृष्ठ-१४मे देल गेल घड़ीक चलबाक दिशाबला कुण्डली नै वरन् घड़ी चलबाक उनटा दिशामे चलैबला कुण्डली थिक! .. even eggs (see how this spiral goes the other way (anti-clockwise) as compared to the clockwise spiral on page 14?)!



पैघ संरचना सभ जेना'हरिकेन' चक्रवात आ किछु आकाशगंगा सेहो फिबोनाची कुण्डली संरचना बनबैत अछि। आश्चर्य!

Even larger structures like hurricanes and even some galaxies seem to follow the Fibonacci Spiral pattern. Fascinating, isn’t it?

मोटामोटी..

फिबोनाची अंकक विवरणक बाद इतिहासक पन्नासँ अन्त मे किछु तथ्य फिबोनाची अंक शृंखलाक सम्बन्धमे। ११म शताब्दीमे माने आइसँ मोटामोटी एक हजार बर्ख पहिने ,आइ-काल्हिक गुजरातमे हेमचन्द्र नामक एकटा जैन विद्वान आ श्रमन छला। पद्य आ संगीतक अध्ययनक क्रममे ओ एकटा अद्भुत अंक-शृंखलाक खोज केलनि! संगीतक कतेक दीर्घ आ लघु स्वरक मिलनसँ लय बनैत अछि, ओ तकर शोध कऽ रहल छलाह। ऐ आविष्कारक सय साल बाद बर्ख १२०२ ई मे लियोनार्ड फिबोनाची (११७०-१२५० ई.) जे इटलीक गणितज्ञ रहथिअपन पोथी 'लिबेर अबाशी' माने 'गणना पुस्तक' मे ओइ अंक शृंखलाक विषयमे लिखलन्हि। फिबोनाची भूमध्यसागर तटपर भ्रमण लेल बहरा जाइ छलाह आ ओइ रस्तामे विश्राम करैत पूर्व देशक बनिजार लोकनिसँ भेँट भेलापर हुनकासँ पुछैत छलाह जे ओइ देशक लोक अंक-गणना कोना करैत अछि। किंशाइत ओ व्यापारी सभ हेमचन्द्रक अंक-शृंखलाक विषयमे हुनका जानकारी देने होइन्ह। आ किएक तँ यूरोपमे एकर ज्ञान फिबोनाचीये पसारलन्हि , सम्पूर्ण जगतमे ई 'फिबोनाची अंक-शृंखला' (फिबोनाची सेक्वेंस)क नामसँ प्रसिद्ध भेल ।

A BRIEF HISTORY

To end this exciting tale of Fibonacci Numbers, let's touch briefly upon the history of the Fibonacci Number Sequence.

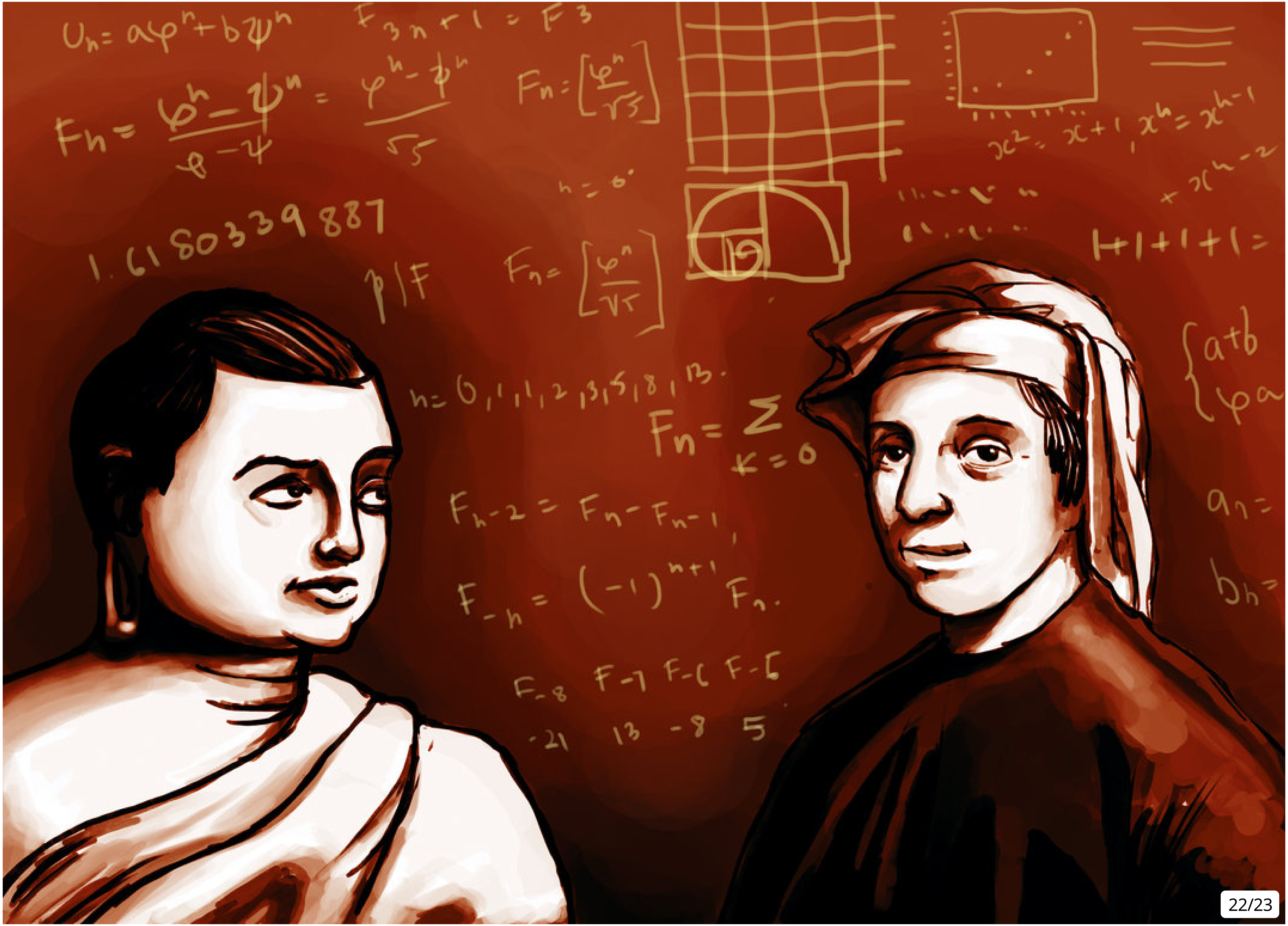
In the 11th century (almost 1000 years ago), a Jain scholar and monk called Hemachandra, who lived in present-day Gujarat, discovered an interesting mathematical pattern while studying poetry and music. He was looking at the number of different ways in which you could combine 'long' and 'short' sounds in music to create different rhythmic patterns.

Around 100 years later, an Italian mathematician called Leonardo Fibonacci (c.1170 – c.1250) – wrote about the very same mathematical pattern in his book *Liber Abaci,* or 'Book of Calculation' in 1202. Fibonacci travelled extensively along the Mediterranean coast, meeting merchants from the East and finding out about how they did mathematics.

It is possible that Fibonacci came across Hemachandra's sequence during his travels, but since he was the first one to introduce it to Europe, these numbers became known to the world as the Fibonacci Sequence.

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Previous



1.6180339887
n = 0, 1, 1, 2, 3, 5, 8, 13.
F_{n-2} = F_n − F_{n-1}
F_{-n} = (−1)^{n+1} F_n.
F_{-8} F_{-7} F_{-6} F_{-5}
-21 13 -8 5

मुदा ऐपर ध्यान दिअ! प्रकृतिमे फिबोनाची अंक शृंखलाक अलाबे आनो अंक शृंखला बा बिन शृंखलाक उदाहरण भेटैत अछि- जेना चारि पातबला क्लोवर आकि चारि पँखुरिबला फूल सभ।

मुदा ई गप चकित करैए जे प्रकृतिमे जतऽ देखू ओतऽ फिबोनाची अंक शृंखलाबला उदाहरण भेटिते अछि। अखन धरि वैज्ञानिक लोकनि ऐ गपक उत्तर नै दऽ सकल छथि जे प्रकृति आ फिबोनाची अंक शृंखलामे एतेक मेल किए छै। भऽ सकैए अहीं पैघ भऽ कऽ एकर उत्तर दऽ सकी।

A word of caution: Although there are many examples in nature that seem to follow the Fibonacci pattern, there are also many examples in nature that do not – like four leaved clovers, or flowers with 4 petals.

What's intriguing, though, is how often these Fibonacci Numbers do appear in nature. So far, scientists haven't figured out WHY nature seems to love Fibonacci numbers so much.

Maybe **YOU** can find the answer when you grow up!



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अद्भुत फिबोनाची अंक-शृंखला

The Fascinating Fibonaccis

(Maithili-English)

मोटा-मोटी हजार बर्ख पहिने भारतीय गणितज्ञ हेमचन्द्र एकटा अद्भुत अंक-शृंखला तकलनि। सय बर्खक बाद ऐपर इटलीक गणितज्ञ फिबोनाची लिखलनि। फिबोनाची अंक-शृंखला सरल-अद्भुत् अछि कारण प्रकृतिक ढेर-रास फूल-पात आदिमे एकर पुनरावृत्ति होइत अछि। बुझू आर नीक जकाँ! Almost a thousand years ago, an Indian scholar called Hemachandra discovered a fascinating number sequence. A century later, the same sequence caught the attention of Italian mathematician Fibonacci, who wrote about it. The Fibonacci sequence was repeated many, many times in nature - in flowers etc. Find out more!

This is a Level 4 book for children who can read fluently and with confidence.